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Steed et al.

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(54) **CLEAR FLUID PATTERNING ON PAPER MEDIA**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(51) **Int. Cl.**
B41J 2/17 (2006.01)
B41J 2/015 (2006.01)

(52) **U.S. Cl.** 347/98; 347/20; 347/21; 347/95; 347/101

(58) **Field of Classification Search** 347/21, 347/98
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS
8,079,694 B2 * 12/2011 Steed et al. 347/98

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GB 2353761 A 7/2001
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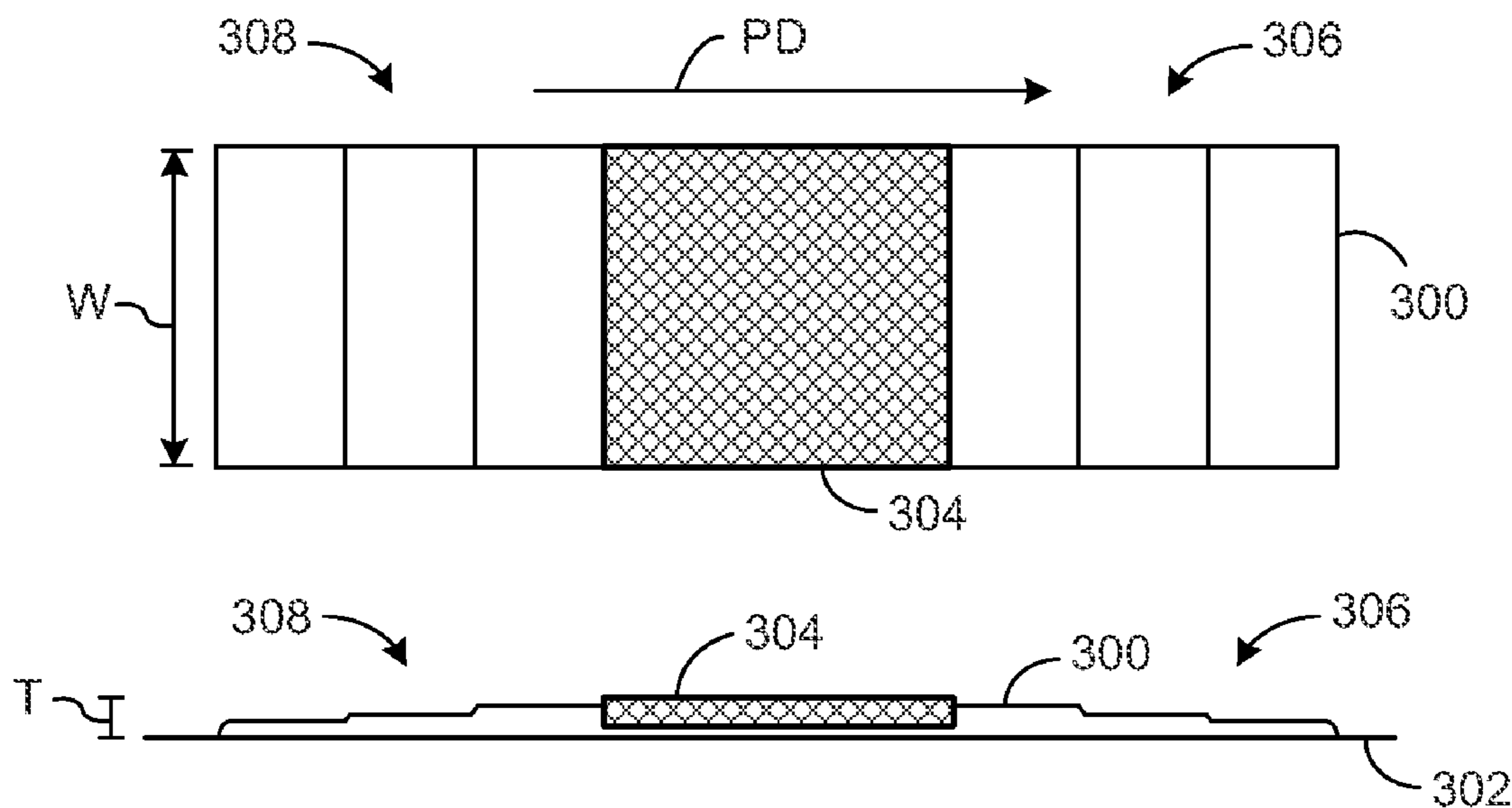
Primary Examiner — Ryan Lepisto

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(57) **ABSTRACT**

Methods and means for imaging on paper media are provided. A data file of an image to be printed is analyzed. A pattern for a clear fluid is determined according to the analysis. The pattern of clear fluid is applied to a paper media traveling in a particular direction, wherein the pattern is generally elongated along the direction of travel. The pattern of clear fluid is defined by a maximum width that is generally equal to the maximum width of the image to be formed. One or more colored inks are applied such that the image is formed and is supported by the paper media. The paper media exhibits reduced cockle as a result of the pattern of clear fluid.

10 Claims, 3 Drawing Sheets



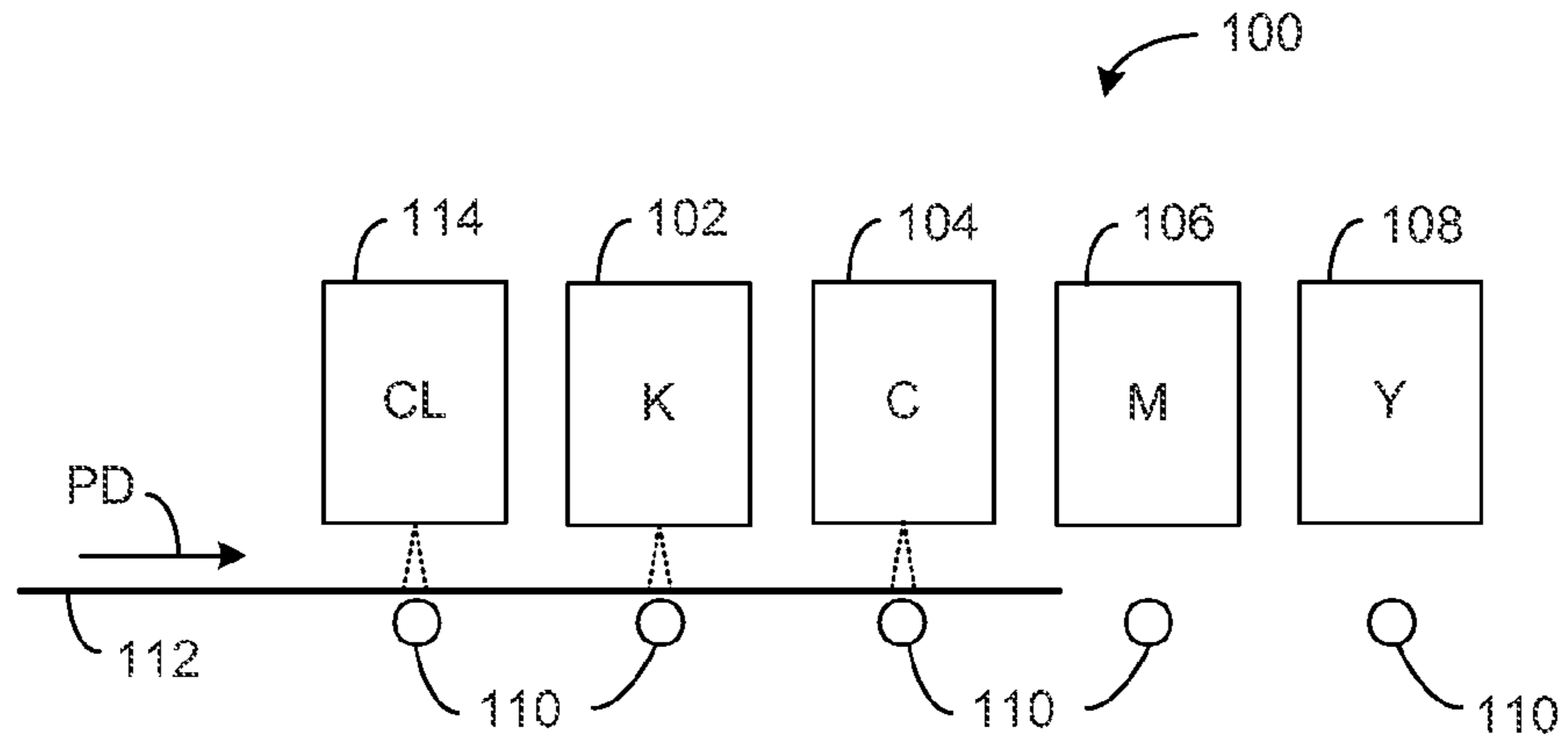


FIG. 1

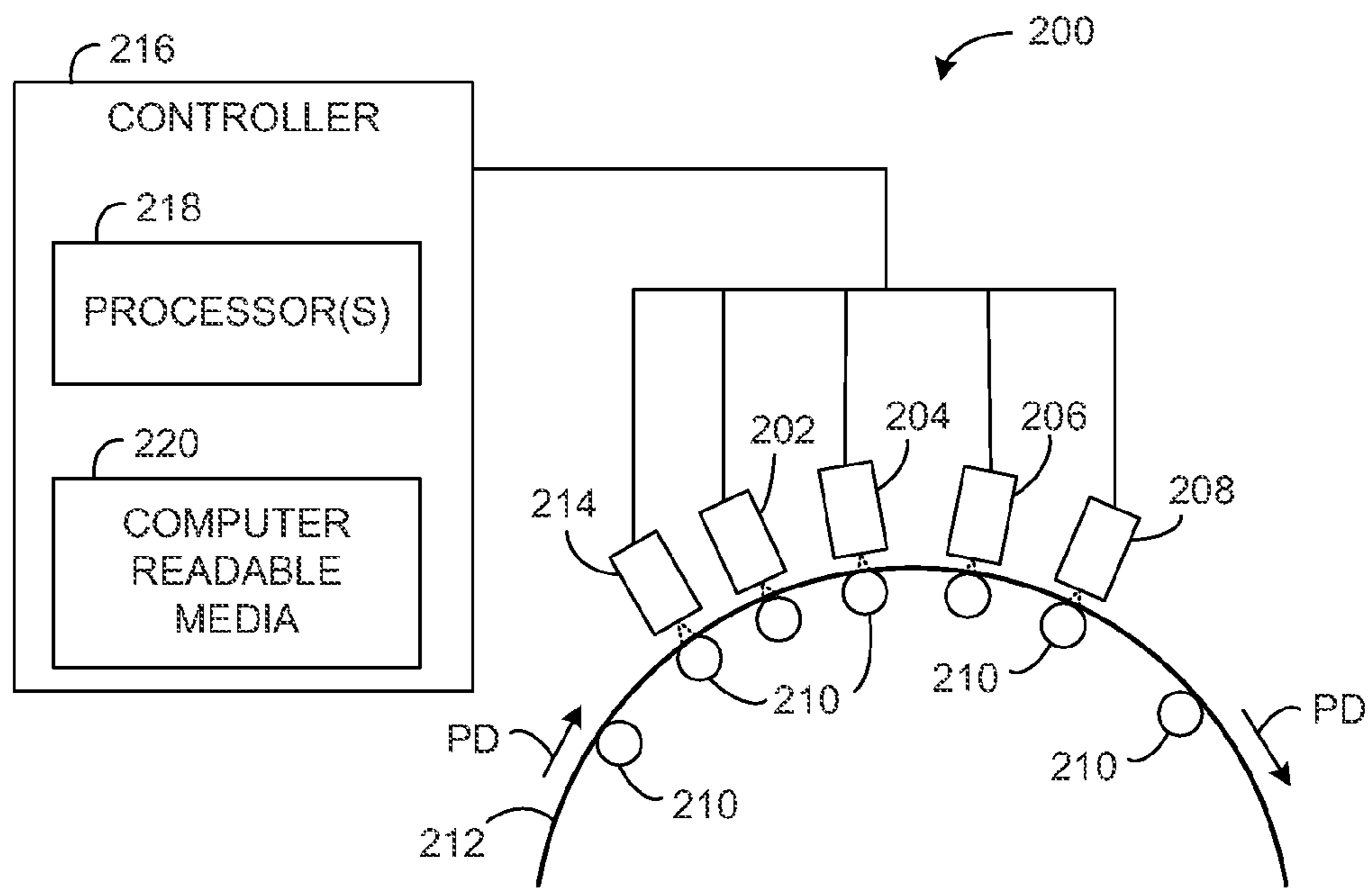


FIG. 2

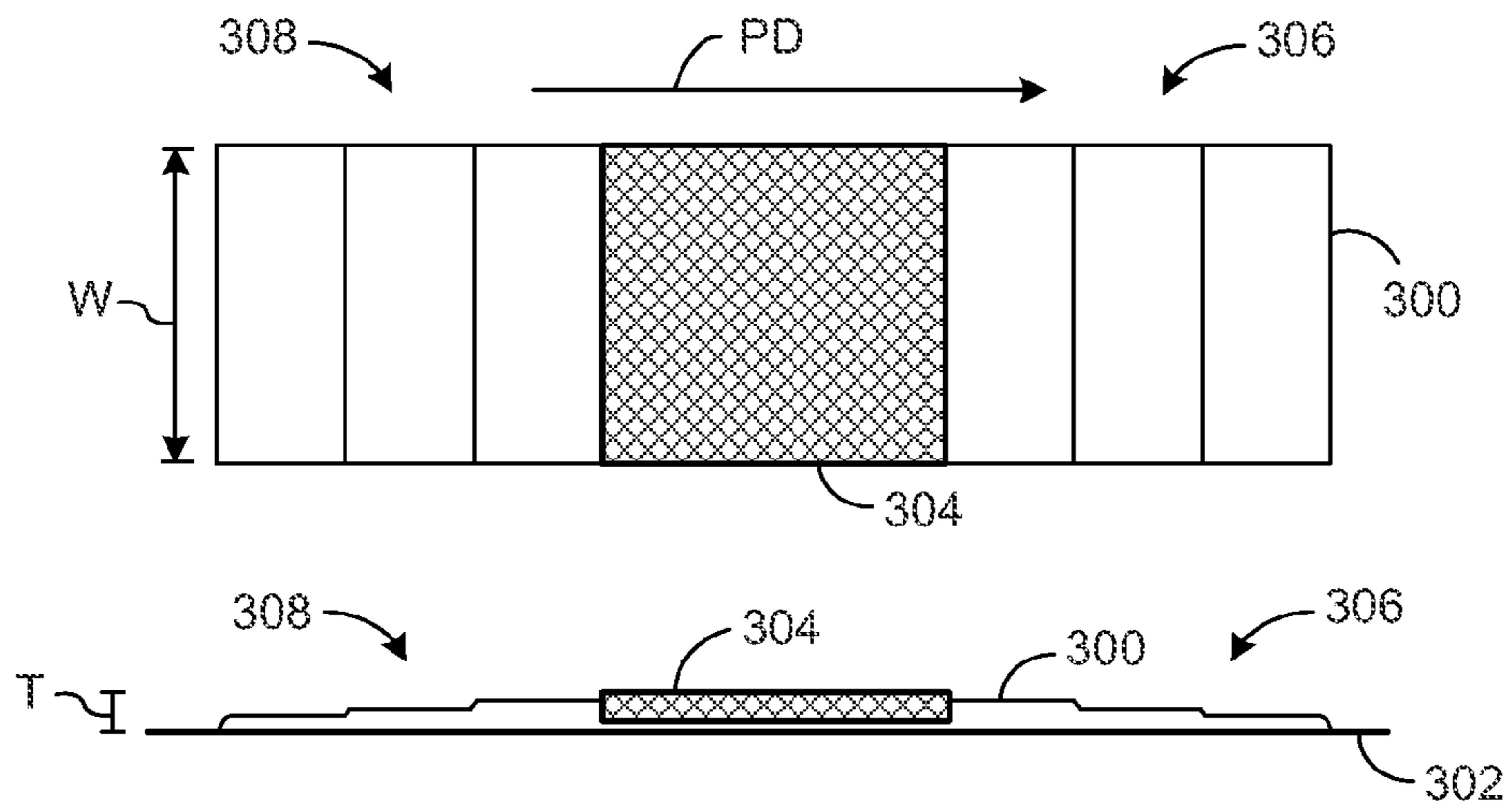


FIG. 3

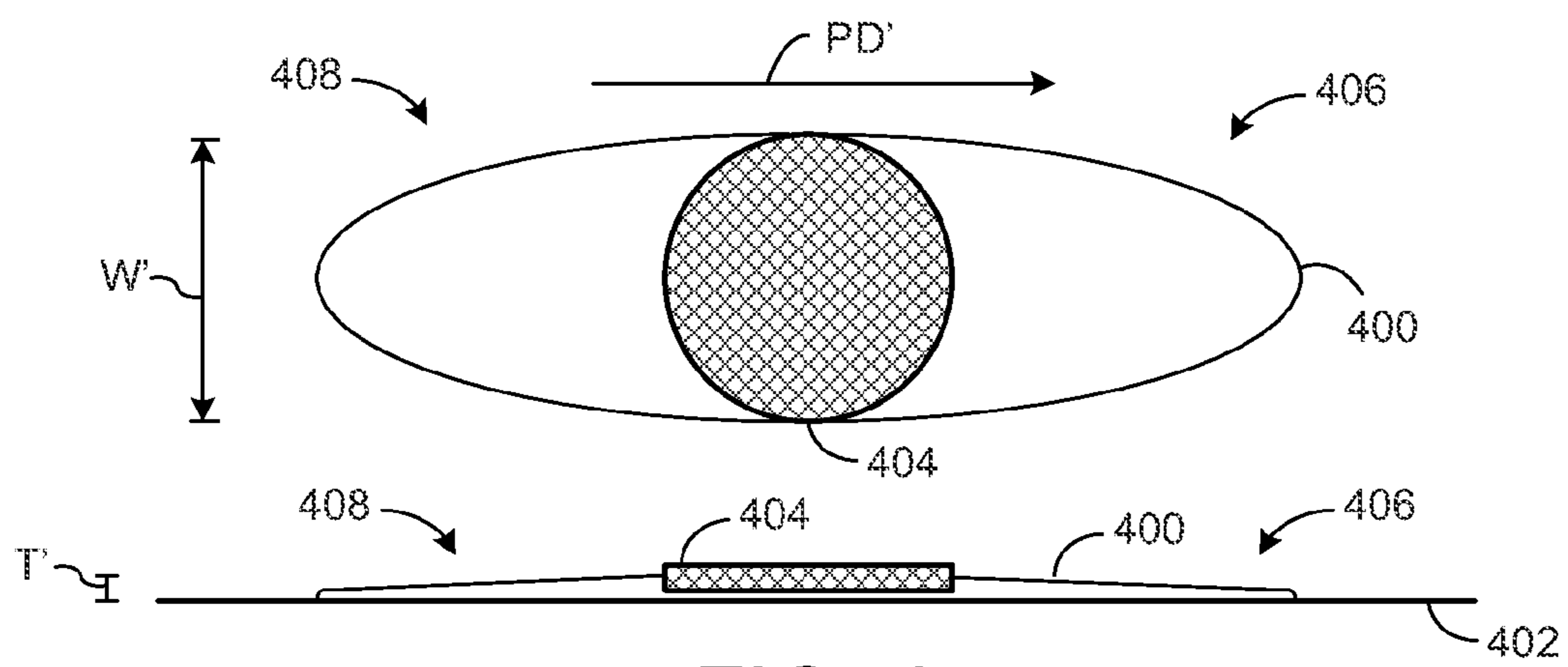


FIG. 4

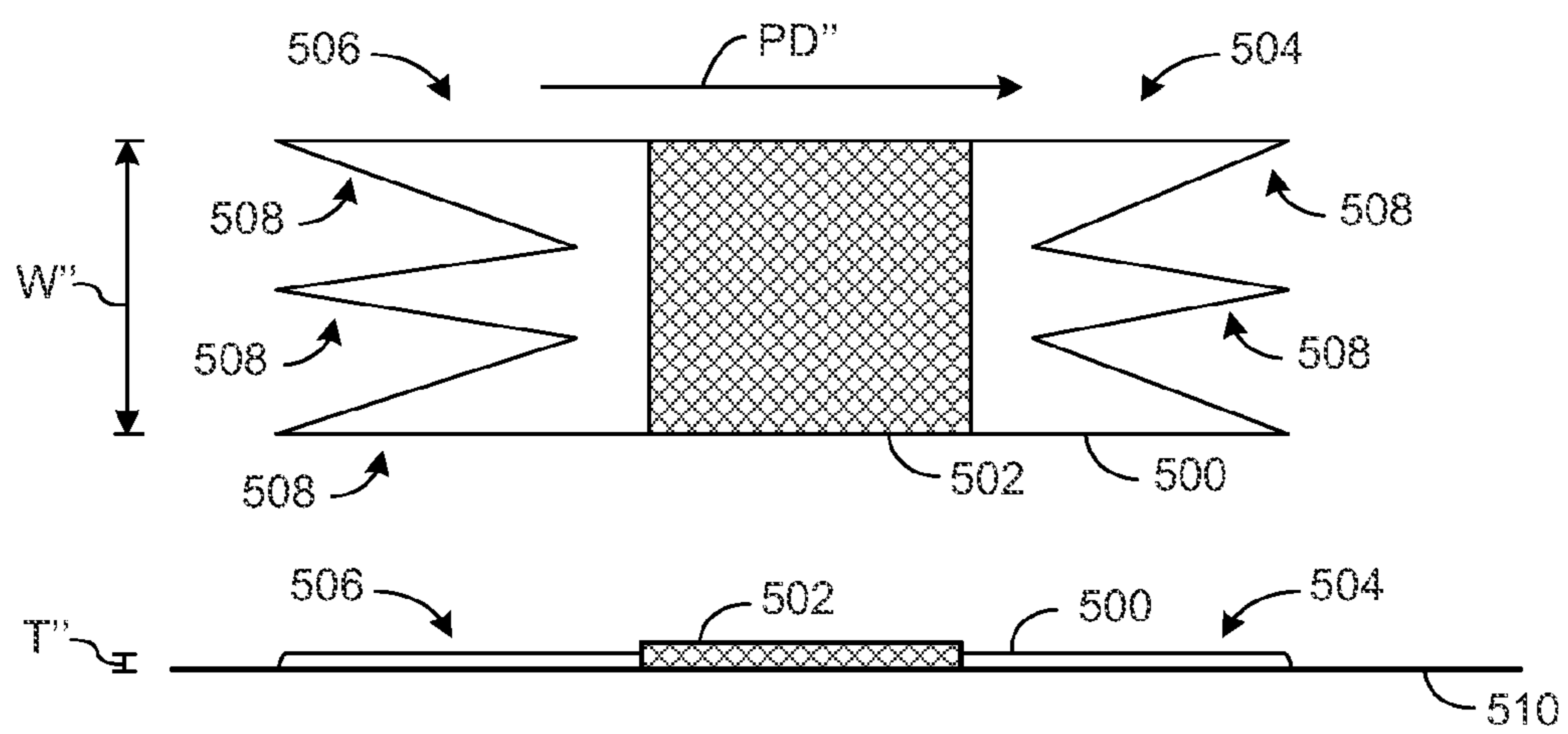


FIG. 5

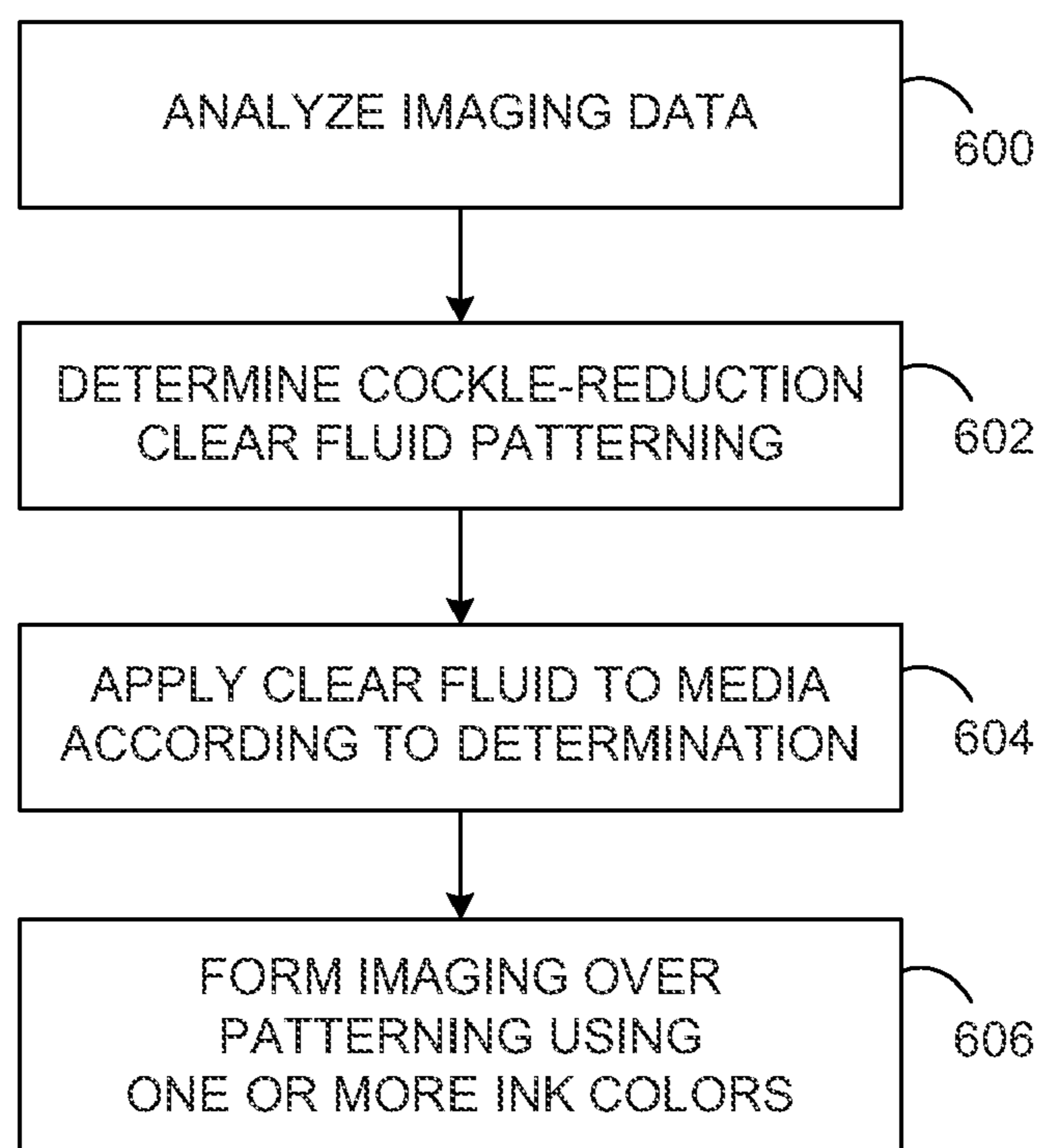


FIG. 6

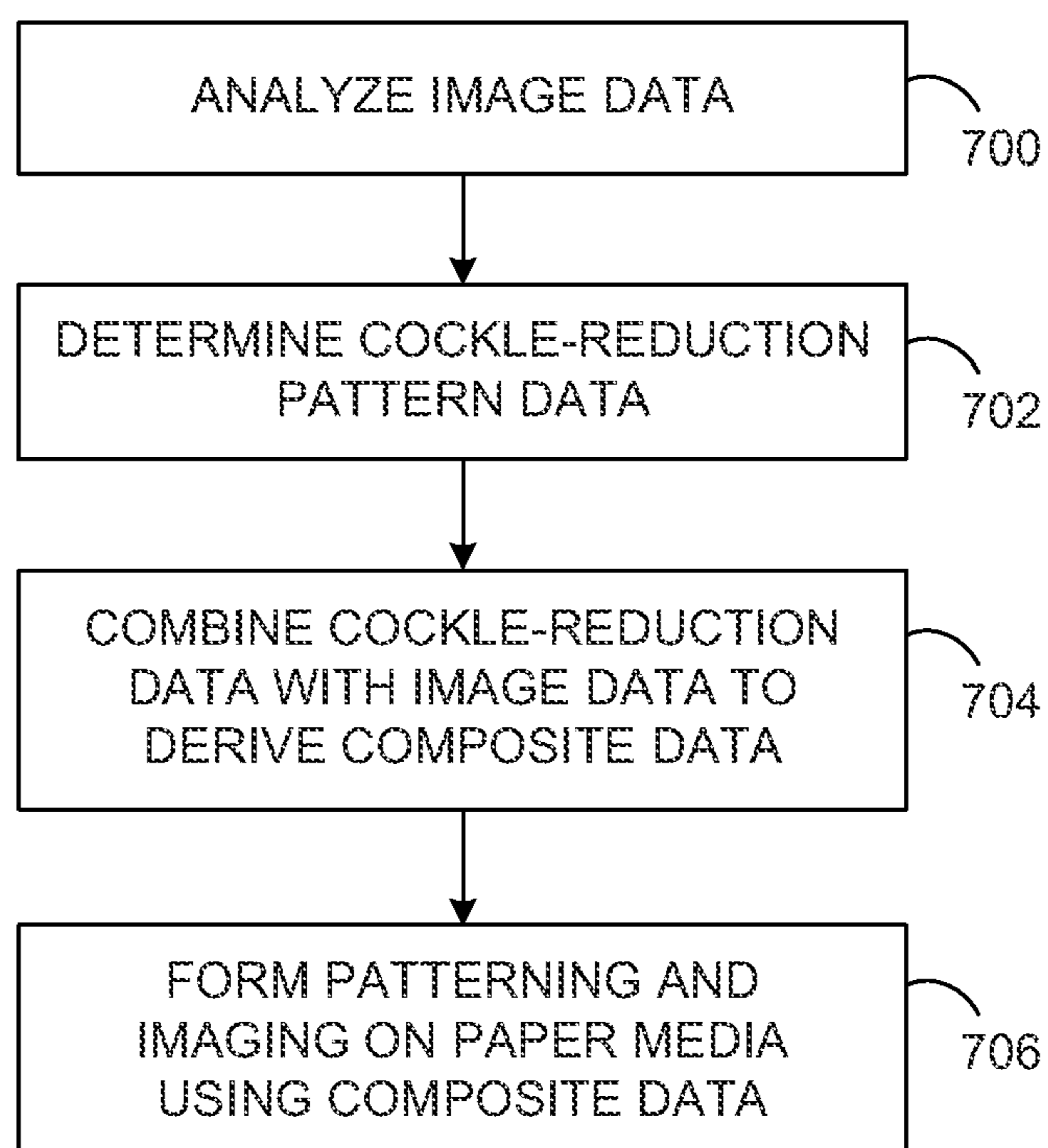


FIG. 7

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CLEAR FLUID PATTERNING ON PAPER MEDIA

PRIORITY CLAIM TO COPENDING APPLICATION

This application is a Continuation and claims the benefit of copending U.S. patent application Ser. No. 12/270,467, as filed on Nov. 13, 2008, now U.S. Pat. No. 8,079,694 titled CLEAR FLUID PATTERNING ON PAPER MEDIA, and naming Mike Steed and Lluís Abello as inventors.

BACKGROUND

One known area of printing involves the jetting of ink onto paper media. Water content within such inks causes paper to dimple or form sinusoidal-like contours due to the swelling of paper. These contours or “cockle” include peaks and valleys such that the peaks may contact subsequent printheads or other mechanisms during the printing process. Contact can result in smearing, streaking or other damage to the images formed on the paper media. Additionally, the cockle formed in the paper may persist, even after the imaging has fully dried.

Paper that has cockled is not compatible with sharp bends around rollers, tightly wound rolls, or other aspects of some mechanized printing processes. As a result, cockled paper sometimes exhibits permanent creases or wrinkles due to process steps performed subsequent to imaging by the printheads.

Accordingly, the embodiments described hereinafter were developed in light of these and other drawbacks associated with the cackling of paper due to ink imaging.

BRIEF DESCRIPTION OF THE DRAWINGS

The present embodiments will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 depicts a schematic view of a printing system according to one embodiment;

FIG. 2 depicts a schematic view of a printing system according to another embodiment;

FIG. 3 depicts a pattern of clear fluid according to one embodiment;

FIG. 4 depicts a pattern of clear fluid according to another embodiment;

FIG. 5 depicts a pattern of clear fluid according to yet another embodiment;

FIG. 6 depicts a flow diagram of a method according to one embodiment;

FIG. 7 depicts a flow diagram of a method according to another embodiment.

DETAILED DESCRIPTION

Introduction

Methods and means for imaging on paper media are provided. In one embodiment, a data file of an image is analyzed prior to being printed (i.e., formed in ink on paper media). A pattern for a clear fluid is determined according to the analysis. The pattern of clear fluid is applied to a paper media traveling in a particular direction, wherein the pattern is generally elongated along the direction of travel. One or more colored inks are applied such that the image is formed and is supported by the paper media. In some embodiments, the one or more colored inks are applied over a portion of the pattern

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of clear fluid. The paper media thus processed and imaged exhibits substantially reduced cockle as compared to known techniques.

In one embodiment, an apparatus is configured to determine a pattern in accordance with an image to be printed. The pattern is configured to reduce cockling of a paper media. The apparatus is also configured to transport the paper media in a direction of travel and to apply a clear fluid to the paper media so as to define the pattern. The apparatus is further configured to apply one or more colored inks so as to form the image. The pattern at least contacting the image and extending away there from. The pattern is defined by a maximum width about equal to that of the image, and the pattern is elongated in the direction of travel of the paper media. The pattern has a non-uniform thickness profile decreasing in thickness in at least one direction extending away from the image.

In another embodiment, an apparatus is configured to determine a pattern in accordance with an image to be printed. The pattern is configured to reduce cackling of a paper media. The apparatus is also configured to transport the paper media in a direction of travel, and to apply a clear fluid to the paper media so as to define the pattern. The apparatus is further configured to apply one or more colored inks so as to form the image, the pattern at least contacting the image and extending away there from. The pattern is defined by a maximum width about equal to that of the image. The pattern is elongated in the direction of travel of the paper media, and is decreasing in width in at least one direction extending away from the image.

In yet another embodiment, a controller is configured to determine a pattern in accordance with an image to be printed. The pattern is configured to reduce cackling of a paper media. The controller is also configured to cause a printing apparatus to apply a clear fluid to the paper media so as to define the pattern. The controller is further configured to cause the printing apparatus to apply one or more colored inks so as to form the image. The pattern at least contacting the image and extending away there from. The pattern is defined by a maximum width about equal to that of the image. The pattern is elongated in a direction of travel of the paper media. Additionally, the pattern at least decreases in width in at least one direction extending away from the image, or has a non-uniform thickness profile decreasing in thickness in at least one direction extending away from the image.

First Illustrative Embodiment

FIG. 1 depicts a printing system 100 according to one embodiment. The system 100 includes a plurality of printheads 102, 104, 106 and 108. Each of the printheads 102-108 is configured to apply a corresponding color of ink (i.e., imaging media) to a receiving media. In one embodiment, each of the printheads 102-108 is defined by a thermal inkjet (TIJ) printing assembly. Other suitable configurations and/or numbers of printheads can also be used. As depicted, the printheads 102, 104, 106 and 108 are associated with black (K), cyan (C), magenta (M) and yellow (Y) inks, respectively. Other sequences, fewer, greater and/or different ink colors, different means for applying ink, etc., can also be used.

The system 100 also includes a plurality of rollers 110 configured to guidingly support a sheet of paper media 112 into operative proximity (i.e., printing range or zone) with the printheads 102-108. In turn, the paper media 112 is propelled (by way of the rollers 110 and/or other means, not shown) past the printheads 102-108 in the direction indicated by the arrow “PD”. In another embodiment (not shown), the rollers 110 are omitted and other means of supporting and/or propelling the paper media are used.

The system 100 also includes a printhead 114 configured to apply a clear fluid such as, for non-limiting example, a bond-

ing agent that is selected to serve as an interface between the paper **112** and the ink(s) applied by the printheads **102-108**. Such a clear bonding agent is available from Hewlett-Packard Company. The printhead **114** is located ahead of the printheads **102-108** with respect to the direction of travel PD (i.e., paper direction) of the paper media **112**. That is, the paper **112** arrives within operative proximity to the printhead **114** before arriving within printing range of the printheads **102-108**. It is to be understood that the system **100** depicts just a portion of a printing apparatus and that other mechanisms and/or processing can be applied which are not germane to the present teachings.

During typical operation, the printhead **114** applies a clear bonding agent (or other suitable clear fluid) to the paper **112** in accordance with the imaging to be formed by the ink printheads **102-108**. Thereafter, the various colors of ink are selectively applied adjacent to and/or over portions of the pattern or patterns of clear fluid by the printheads **102-108** so as to form imaging (e.g., text, figures, indicia, photographs, etc.) on the passing paper media **112**. The respective printheads **102-108** and **114** are understood to operate by way of a corresponding control system or device, not shown in FIG. 1. Further elaboration with respect to such a control system according to the present teachings is provided hereinafter.

According to the present teachings, the printhead **114** applies a clear bonding agent (or other suitable clear fluid) to the paper **112** in a pattern ahead of and behind, and possibly beneath, the imaging formed by the color ink printheads **102-108**. That is, the clear fluid (e.g., bonding agent, water, etc.) is applied so as to define leading and trailing regions (with respect to the colored ink) in any suitable pattern that is generally elongated along the direction of travel PD of paper **112**. Non-limiting examples of such clear fluid patterning are described hereinafter with respect to FIGS. 3-5. In any case, the system **100** is configured and controlled so as to pattern those portions of the paper **112** with a clear fluid in such a way as to substantially reduce or eliminate cockle.

Second Illustrative Embodiment

FIG. 2 depicts a printing system **200** according to one embodiment. The system **200** includes a plurality of printheads **202, 204, 206** and **208**. Each of the printheads **202-208** is configured to apply a corresponding color of ink (i.e., imaging media). According to one embodiment, each of the printheads **202-208** is defined by a thermal inkjet (TIJ) printhead. Other printhead types can also be used. In any case, the printheads **202-208** are configured to selectively emit ink of respective colors so as to form images (e.g., text, figures, photographs, etc.) onto paper media **212**.

The system **200** also includes a plurality of rollers **210** configured to guide and support a long web (or ribbon) of paper media **212** along a pathway that is arcuate (i.e., non-planar) while passing within operative proximity (i.e., printing range) of the printheads **202-208**. In turn, the paper media **212** is understood to be drawn from a supply roll (not shown), routed through the printing system **200** and any other aspects (not shown) thereof, and collected in rolled form on take-up roll (not shown). In another embodiment, the paper media is cut into discrete sheets and/or folded and there is no take-up roll, as such. In any case, the system **200** can also be referred to as a web printing system.

The system **200** also includes a printhead **214** configured to emit or jet a clear fluid such as, for non-limiting example, a bonding agent upon the paper media **212** prior to its arrival within printing range of the printheads **202-208**. The printhead **214** is selectively controlled so as to apply a pattern or

patterns of clear bonding agent (or other fluid) to the paper **212** in accordance with the imaging to be formed by the printheads **202-208**.

The system **200** further includes a controller **216** having one or more processors **218**. The processor(s) **218** operate(s) in accordance with program code stored on computer readable media **220**. Non-limiting examples of computer readable media **220** include magnetic storage media, optical storage media, solid-state random access memory (RAM), read-only memory, (ROM), and non-volatile solid-state storage media. Other suitable forms of computer readable media **220** can also be used. It is to be understood that the system **200** depicts just a portion of a web printing apparatus and that other mechanisms and/or processing can be applied which are not germane to the present teachings.

Under typical operation, the controller **216** controls operations of the printheads **202-208** and **214** according to the program code stored on the computer readable media **220**. In particular, the controller **216** controls the operation of the printhead **214** so as to selectively form patterns of a clear bonding agent (or water or other fluid) on the paper media **212**. The controller **216** further controls operation of the color ink printheads **202-208** such that images are formed on the pattern or patterns of clear bonding agent and are thus bound to the paper media **212**. The clear bonding agent is patterned on the paper **212** so that leading and trailing regions are defined extending away from the ink imaging and elongated along the direction of travel indicated by arrows PD. The clear bonding agent is further patterned such that a maximum width thereof is about equal to (i.e., does not significantly exceed) the maximum width of the image or images formed in colored ink(s).

Third Illustrative Embodiment

FIG. 3 depicts a plan view and a side elevation view of an illustrative and non-limiting pattern **300** of clear fluid in accordance with the present teachings. The pattern **300** is applied to and supported by a paper media **302**. The paper media **302** is understood to be in motion in a direction PD at the time the pattern **300** is being applied. An area of black ink **304**, representing an illustrative and non-limiting image of a filled-in square, is applied over (i.e., onto) a central portion of the clear fluid pattern **300**. The black ink **304** (or any other colored ink) soaks (i.e., seeps, or encroaches) at least partway into the pattern **300**. In some instances, the colored ink can seep completely through the pattern of clear fluid and into contact with the underlying paper media.

The pattern **300** includes a leading edge portion **306** and a trailing edge portion **308**. The pattern **300** is characterized by a substantially constant width W . It is noted that the maximum width W of the pattern **300** is about equal to the width of the black ink **304**. The pattern **300** can optionally have a maximum width W that slightly exceeds the width of the black ink **304** so as to ensure a complete foundation on the paper media **302** beneath the black ink **304**. In any case, the pattern **300** has a relatively simple, rectangular width profile when considered from end-to-end.

The pattern **300** is further characterized by a progressive, generally step-wise decrease in applied quantity (or application density), which is depicted as thickness T in the interest of clarity of understanding. The applied quantity of the pattern **300** decreases in opposite directions extending away from the applied ink **304** and along the direction of travel PD. Thus, the pattern **300** has a particular application profile when considered from end-to-end. As depicted, the application profile (i.e., thickness) of FIG. 3 is exaggerated in the interest of illustration and understanding. The pattern **300** is elongated

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along the direction of travel PD. The pattern 300 helps to substantially reduce cockle of the paper media 302.

Fourth Illustrative Embodiment

FIG. 4 depicts a plan view and a side elevation view of another illustrative and non-limiting pattern 400 of clear fluid in accordance with the present teachings. The pattern 400 is applied to and supported by a paper media 402. The paper media 402 is understood to be in motion in a direction PD at the time the pattern 400 is applied. An area of black ink 404, representing an illustrative and non-limiting image of a filled-in circle (i.e., a disk), is applied over (i.e., onto) a central portion of the clear fluid pattern 400.

The pattern 400 includes a leading edge portion 406 and a trailing edge portion 408. The pattern 400 is characterized by a width profile that is generally elliptical when considered from end-to-end. It is noted that the maximum width W' of the pattern 400 is substantially equal to (i.e., is not appreciably greater than) the maximum width of the black ink 404.

The pattern 400 is also characterized by a uniform application profile (thickness T') in the central portion directly underlying the black ink 404. The pattern 300 is further characterized by a progressive, generally linear decrease in applied quantity extending in opposite directions away from the applied ink 404 and along the direction of travel PD'. The pattern 400 therefore exhibits a particular application profile (i.e., thickness T) when considered from end-to-end. The pattern 400 is elongated along the direction of travel PD'. The pattern 400 is configured to substantially reduce cockle of the paper media 402.

Fifth Illustrative Embodiment

FIG. 5 depicts a plan view of still another illustrative and non-limiting pattern 500 of clear fluid in accordance with the present teachings. The pattern 500 is applied to and supported by a paper media (not shown). The paper media is understood to be in motion in a direction PD'' at the time the pattern 500 is applied. An area of black ink 502, representing an illustrative and non-limiting image of a filled-in square, is applied directly onto paper media 510. Thus, none of the pattern 500 of clear fluid (i.e., water) underlies the black ink 502. Rather, the pattern 500 is applied so as to define only leading and trailing areas about the black ink 502.

The pattern 500 includes a leading edge portion 504 and a trailing edge portion 506. The pattern 500 is characterized by an overall, maximum width W'' . It is noted that the maximum width W'' is about equal to the width of the black ink 502. The pattern 500 is also characterized by a plurality of triangular peninsulas or pennant-like extensions 508 that individually taper away from the area of black ink 502. As such, the pattern 500 has a relatively complex width profile as compared to those of patterns 300 and 400 described above.

The pattern 500 is further characterized by a uniform application quantity (or thickness T'') throughout. Thus, the pattern 500 has a relatively simple application profile as compared to those of patterns 300 and 400 described above. The pattern 500 is elongated along the direction of travel PD''.

The patterns 300, 400 and 500 are illustrative of any number of suitable patterns of clear fluid (e.g., bonding agent, water, etc.) applied to a paper media prior to the application of one or more overlying colored inks. Other suitable patterns can also be used in accordance with the image to be formed in colored ink. Simple image shapes—namely, solid squares and a disk—are depicted in FIGS. 3-5 in the interest of clarity and understanding. However, it is to be understood that more complex image shapes (e.g., letters, numbers, symbols, line graphics, photographic content, etc.) can be suitably accommodated by way of respective clear fluid patterns configured to reduce cockle of the supporting paper media.

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In any case, patterns according to the present teachings are generally elongated in the direction of motion of the paper media during the application process. Additionally, such patterns define leading and trailing edges (or regions) that extend away from the colored ink or inks. Patterns according to the present teachings are further defined by respective width and application profiles.

Illustrative Processes

FIG. 6 is a flowchart depicting a method in accordance with one embodiment. The flowchart of FIG. 6 depicts particular method aspects and order of execution. However, it is to be understood that other methods including and/or omitting certain details, and/or proceeding in other orders of execution, can also be used without departing from the scope of the present teachings. Therefore, the method of FIG. 6 is illustrative and non-limiting in nature.

At 600, data defining an image to be printed in ink media is analyzed by automated means (e.g., controller 216, etc.). The image can include any of text, symbols, indicia, photographic imaging, etc. In any case, the data defines imaging to be formed over paper media using one or more colors of liquid ink.

At 602, one or more patterns of clear fluid are determined in accordance with the analysis at 600 above. The pattern(s) are determined so as to reduce cockle of the paper media upon which the image is to be formed. The respective patterns can be similar or dissimilar in characteristics such as, for non-limiting example, application profile, width profile, etc.

At 604, a suitable clear fluid, such as a bonding agent, is applied to a moving paper media such that the pattern or patterns determined at 602 above are formed.

At 606, ink printing is performed in one or more colors adjacent to the pattern or patterns formed at 604 above. None, some or all of the colored ink(s) may overlie the pattern of clear fluid. In this way, the image represented by the data is formed over and supported by the paper media. In turn, the clear fluid patterning serves to substantially reduce subsequent cackling of the paper media.

FIG. 7 is a flowchart depicting a method in accordance with another embodiment. The flowchart of FIG. 7 depicts particular method aspects and order of execution. However, it is to be understood that other methods including and/or omitting certain details, and/or proceeding in other orders of execution, can also be used without departing from the scope of the present teachings. Therefore, the method of FIG. 7 is illustrative and non-limiting in nature.

At 700, an image to be printed is analyzed by automated means (e.g., controller 216, etc.). Typically, digital data representing the image is under scrutiny during the analysis. The image can include any of text, symbols, indicia, photographic imaging, etc. In any case, the imaging is to be supported by paper media using one or more colors of liquid ink.

At 702, patterning of clear fluid is determined in accordance with the image analysis at 700 above. The determined patterning is such so as to reduce cockle of paper media upon which the image is to be formed. The respective patterns can be similar or dissimilar in characteristics such as, for non-limiting example, application profile, width profile, etc. In any event, portions of the patterning are determined so as to extend outward and away from those areas to be imaged in colored ink. The determined patterning is represented as digital data in a format compatible with the data representing the image.

At 704, the image data and the patterning data are combined so as to derive a composite data file representing the image and the underlying, cockle-reduction patterning,

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At **706**, the composite data file derived at **704** above is used to control the application of the clear fluid patterning and the one or more colored inks to a moving paper media by way of corresponding printheads. In this way, the image is formed over and supported by the paper media, while the clear fluid (e.g., bonding agent) patterning serves to reduce paper cockle.

In general, the foregoing description is intended to be illustrative and not restrictive. Many embodiments and applications other than the examples provided would be apparent to those of skill in the art upon reading the above description. The scope of the invention should be determined, not with reference to the above description, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. It is anticipated and intended that future developments will occur in the arts discussed herein, and that the disclosed systems and methods will be incorporated into such future embodiments. In sum, it should be understood that the invention is capable of modification and variation and is limited only by the following claims.

What is claimed is:

1. An apparatus configured to:
determine a pattern in accordance with an image to be printed, the pattern configured to reduce cockling of a paper media;
transport the paper media in a direction of travel;
apply a clear fluid to the paper media so as to define the pattern; and
apply one or more colored inks so as to form the image, the pattern at least contacting the image and extending away there from, the pattern defined by a maximum width about equal to that of the image, the pattern being elongated in the direction of travel of the paper media, the pattern having a non-uniform thickness profile decreasing in thickness in at least one direction extending away from the image.
2. The apparatus according to claim **1** further configured such that the clear fluid does not underlie any of the one or more colored inks.
3. The apparatus according to claim **1** further configured such that the pattern decreases in width in at least one direction extending away from the image.
4. The apparatus according to claim **1** further configured to transport the paper media along a non-planar pathway during

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at least the applying of the clear fluid or the applying of the one or more colored inks so as to form the image.

5. An apparatus configured to:
determine a pattern in accordance with an image to be printed, the pattern configured to reduce cockling of a paper media;
transport the paper media in a direction of travel;
apply a clear fluid to the paper media so as to define the pattern; and
apply one or more colored inks so as to form the image, the pattern at least contacting the image and extending away there from, the pattern defined by a maximum width about equal to that of the image, the pattern being elongated in the direction of travel of the paper media, the pattern decreasing in width in at least one direction extending away from the image.
6. The apparatus according to claim **5** further configured to transport the paper media along a non-planar pathway during at least the applying of the clear fluid or the applying of the one or more colored inks so as to form the image.
7. The apparatus according to claim **5** further configured such that the clear fluid does not underlie any of the one or more colored inks.
8. A controller configured to:
determine a pattern in accordance with an image to be printed, the pattern configured to reduce cockling of a paper media;
cause a printing apparatus to apply a clear fluid to the paper media so as to define the pattern; and
cause the printing apparatus to apply one or more colored inks so as to form the image, the pattern at least contacting the image and extending away there from, the pattern defined by a maximum width about equal to that of the image, the pattern being elongated in a direction of travel of the paper media, the pattern at least:
decreasing in width in at least one direction extending away from the image; or
having a non-uniform thickness profile decreasing in thickness in at least one direction extending away from the image.
9. The controller according to claim **8**, the controller including at least one processor configured to operate in accordance with a program code.
10. The controller according to claim **8**, the controller including a computer-readable storage media having a program code.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 8,215,759 B2
APPLICATION NO. : 13/291598
DATED : July 10, 2012
INVENTOR(S) : Mike Steed et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In column 8, line 4, in Claim 5, delete "h" and insert -- with --, therefor.

Signed and Sealed this
First Day of January, 2013

A handwritten signature in black ink that reads "David J. Kappos". The signature is written in a cursive style with a large initial "D" and "K".

David J. Kappos
Director of the United States Patent and Trademark Office